Relative laboratory volatility of Dicamba in closed dome systems with varied pH

Report: MRID 50958207. Lane, T.E., B.D. Hopp, and S. Grant. 2020. Dicamba. Laboratory Study to Determine the Effect of Water pH in Tank Mixtures on Volatility Potential of Dicamba. Final Report. Unpublished study performed by Battelle Memorial Institute (BMI), West Jefferson, Ohio, and Battelle Memorial Institute (BMI), Norwell, Massachusetts, and sponsored and submitted by Syngenta Crop Protection, LLC, Greensboro, North Carolina. Report No. and BMI Study No.: C05624. Task No. TK0457681. Study initiated September 30, 2019 and terminated January 8, 2020 (p. 5). Experiment initiated on November 25, 2019 (completion date not reported; Appendix 1, p. 45). Final report issued January 8, 2020.

Document No.: MRID 50958207

Guideline: Non-guideline

Statements: The study was conducted in compliance with U.S. EPA FIFRA (40 CFR Part 160) GLP standards with the following exceptions (p. 3):

1) The SOP CP III-003 (effective date 09/27/2019) was not in place when the test substance was received on 08/30/2019; therefore, the test substance was stored at standard office conditions (~70 °F) until 10/08/2019 when it was moved to the storage area.
2) The soil characterization data reported in Appendix 2 were not collected following GLP standards
3) The Omron Stopwatch used to measure the spray tracker calibration prior to spraying samples did not have a calibration certificate.
4) The Hydrofarm Quantum PAR Light Meter (no ID or S/N) did not have a calibration certificate.
5) The automated data collection system (Fluke Hydra) for the temperature and flow were collected from calibrated sensors and stored throughout each humidome test. The data collection system (TSI Air Velocity Meter) for humidity was collected from a probe and stored throughout each humidome test. At test termination, data were printed, initialed and dated.
6) The data in Appendix 6 (Sponsor justification of tested tank mixtures) was not collected following GLP procedures. Battelle cannot make any claims regarding the accuracy of the data provided in Appendix 6.

Signed and dated GLP Compliance, Data Confidentiality, and Quality Assurance statements were provided (pp. 2-4). A Certification of Authenticity statement was not provided.

Classification: This study is **supplemental, non-guideline**. The test soil was only partially characterized. The test soil consisted of 50% Berger BM2 Germinating Mix, a soil with a large amount of peat moss, which would make it very high in organic carbon. Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not absolute. The soil weight for each humidome tray and application rate in kg a.e. dicamba/ha were not reported.

PC Code:	128931 (Dicamba DGA); 108800 (S-metolachlor)		
Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	**Signature:** **Date:**	2020.10.22 10:34:03 -04'00'
CDM/CSS-Dynamac JV Reviewers:	Lisa Muto, M.S., Environmental Scientist	Signature: Date: 04/15/2020	
	Joan Gaidos, Ph.D., Environmental Scientist	Signature: Date: 04/15/2020	

This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac Joint Venture personnel. The CDM/CSS-Dynamac JV role does not include establishing Agency policies

Executive Summary

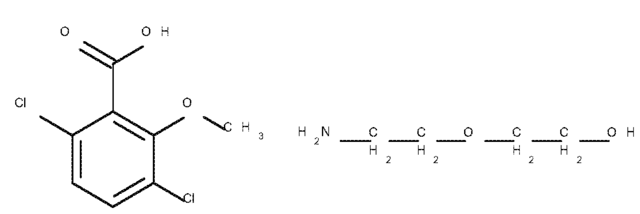
In a laboratory study, the relative dicamba volatility of four tank mixtures of Tavium® with Intact® was investigated on partially characterized soil [(50% Field soil and 50% Berger BM2 Germinating Mix provided by Hummert International (Item # 79VV9600)] under aerobic soil conditions at 35°C with 40% relative humidity for a period of 24 hours. Tavium® with Intact® was partnered with one of three herbicide formulations (Roundup PowerMAX® (RUPM), Flexstar®, and Fusilade® DX). In order to study the effects of pH, the four tank mixtures were prepared at target water pHs of 4, 7, and 8 (final water pHs of 4.28, 7.09, and 8.26). Soil samples were treated at a target application rate of *ca.* 0.56 kg a.e./ha (0.5 lb a.e. dicamba/A), which is the typical use rate on dicamba tolerant soybean and cotton described on the Tavium® label. Three replicates for each pH were examined in the study. Air was pulled through Polyurethane foam (PUF) filters at a flow rate of *ca.* 1.85 L/minute and samples were collected for 24 hours. The PUF samples were extracted using methanol, and dicamba was quantitated using LC-MS/MS. No analyses of dicamba in soil was performed.

Using the Wilcoxon Test, the study author determined that a statistically significant difference (95% confidence level) was observed between the dicamba mass detected at the lowest initial carrier pH (pH 4) and volatilized mass measured when the target water solution was 7 or 8. There was no observed significant difference between 7 and 8 pH levels. Measured mass for the pH 4 experimental data (tank mix pH range 4.46-4.74) ranged from 7,310 to 11,500 ng/PUF. The pH 7 experimental data (tank mix pH range 4.68-5.34) exhibited mass ranges from 4.6 to 791 ng/PUF. The pH 8 (tank mix pH range 6.93-7.90) produced the lowest mass range with values ranging from 6.4 to 24 ng/PUF. The reviewer confirmed these observations graphically.

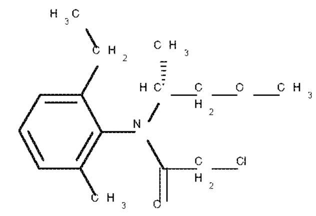
I. Material and Methods

A. Materials

1. Test Material



Dicamba DGA



S-metolachlor

Table 1a. Properties of Test Materials

Property	Tavium®	Intact™	Roundup PowerMAX®	Flexstar®	Fusilade® DX
Product Name	Tavium® with VaporGrip® Technology Design Code: A21472E	Intact™	Roundup PowerMAX® Herbicide	Flexstar®	Fusilade® DX Herbicide
Formulation Type	CS 135.6/271.2 g a.i./L (dicamba/S-metolachlor)	Not reported			
Typical end-use product?	Yes	Not reported			
Function	Herbicide	Drift reducing agent (DRA)	Herbicide	Herbicide	Herbicide
Contaminants and/or impurities	Dicamba - 138 g a.e./L, 12.2% w/w S-metolachlor - 272 g a.i./L, 24.1% w/w. Contaminants not reported	43.18% Polyethylene glycol, choline chloride, guar gum 56.82% Constituents Ineffective as Spray Adjuvants. Contaminants not reported	48.7% Glyphosate, N-(phosphonomethyl) glycine, in the form of its potassium salt. Contaminants not reported	22.1% Sodium salt of fomesafen 5-[2-chloro-4-(trifluoromethyl) phenoxy]-N-(methylsulfonyl)-2-nitrobenzamide. Contaminants not reported	24.5% Fluazifop-P-butyl Butyl (R)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy] propanoate. Contaminants not reported
Manufacture #	Not reported				
Batch ID	1087560 HDM9D25081	374-25	MZZT0904AJ	MHA8A14-HB1	9023011
CAS #	104040-79-1 (dicamba diglycolamine salt) 87392-12-9 (S-metolachlor)	Not applicable	1071-83-6 (glyphosate)	72178-02-0 (fomesafen)	79241-46-6 (fluazifop-P-butyl)
Chemical structure	See image above	Not applicable			
Storage stability	Not reported				

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Property	Tavium®	Intact™	Roundup PowerMAX®	Flexstar®	Fusilade® DX
pH	5.8 at *ca.* 25°C	6.05 at *ca.* 25°C	5.32 at *ca.* 25°C	7.2 at *ca.* 25°C	6.2 at *ca.* 25°C

Data obtained from pp. 10-11, Tables 1-2, p. 21, and Appendix 6, p. 109, of the study report.

Table 1b. Properties of Tank Mixtures

Property		Tank Mix 1 (TM1)	Tank Mix 2 (TM2)	Tank Mix 3 (TM3)	Tank Mix 4 (TM4)
Tank Mix Component 1		Tavium® (56.5 fl. oz./A)	Tavium® (56.5 fl. oz./A)	Tavium® (56.5 fl. oz./A)	Tavium® (56.5 fl. oz./A)
Tank Mix Component 2		None	Roundup PowerMAX® (RUPM; 32 fl. oz./A)	Flexstar® (16 fl. oz./A)	Fusilade® DX (8 fl. oz./A)
Drift Reducing Agent (DRA)		Intact™ 0.5% (v:v)	Intact™ 0.5% (v:v)	Intact™ 0.5% (v:v)	Intact™ 0.5% (v:v)
Target Water pH	4	4.28 (Final Water) 4.62 (Tank Mixture)	4.28 (Final Water) 4.46 (Tank Mixture)	4.28 (Final Water) 4.74 (Tank Mixture)	4.28 (Final Water) 4.62 (Tank Mixture)
	7	7.09 (Final Water) 5.04 (Tank Mixture	7.09 (Final Water) 4.68 (Tank Mixture)	7.09 (Final Water) 5.34 (Tank Mixture)	7.09 (Final Water) 5.03 (Tank Mixture)
	8	8.26 (Final Water) 7.89 (Tank Mixture)	8.26 (Final Water) 6.93 (Tank Mixture)	8.26 (Final Water) 7.90 (Tank Mixture)	8.26(Final Water) 7.89 (Tank Mixture)

Data obtained from Tables 3-4, p. 22, of the study report

2. Storage Conditions

From receipt on 08/30/2019 until 10/08/2019, the test substance was stored at standard office conditions (~70 °F); it was moved to the storage area [<30°C (actual range was 18.0- 24.0°C)] until use (p. 3; Table 1, p. 21; Appendix 1, p. 45).

3. Soil

The test system soil consisted of a pre-sieved (1/4" mesh) of 50/50 mixture of field soil and Berger BM2 Germinating Mix from Hummert International (Item # 79VV9600). According to information obtained from the Internet (https://www.hummert.com/berger-bm2-germinating-mix-10120500), BM2 Germinating Mix is a mixture of fine peat moss, dolomite lime, vermiculite, and perlite which is an indication that the mixture contains a high level of organic carbon. The soil moisture for the batch was measured with an Ohaus MB23 moisture balance prior to loading trays with soil, with a soil moisture target range of 12 – 22%. Soil characteristics are provided in **Table 2**.

Table 2. Soil(s) Collection, Storage and Properties

Property	Field soil	Berger BM2 Germinating Mix
Geographic location	Not reported	
Pesticide use history at the collection site	Not reported	
Collection date	Not reported	
Collection procedures	Not reported	
Sampling depth	Top 6 inch	Not reported
Storage conditions	Not reported	
Storage duration	Not reported Soil samples shipped on 07/29/2019.	
Soil preparation	50% Field soil and 50% Berger BM2 Germinating Mix (sifted with a ¼-in (0.635 cm) opening sieve screen)	
Soil texture (USDA):	Not reported	
% Sand	62.5	Not reported
% Silt	27.5	Not reported
% Clay	10	Not reported
pH (water)	7.5	Not reported
pH	7.3 (salt pH)	5.2-6.0 (undefined)
Organic carbon (%)[1]	0.3	Not reported
Organic matter (%) (LOI)	0.6	Not reported
CEC (meq/100 g) (Method not reported)	13.3	Not reported
Soil Moisture Content (%):	12-22% (target)	
At 0.1 bar (pF 2.0)	Not reported	
At 1/3 bar (pF 2.5)	Not reported	
Bulk density (g/cm^3)	Not reported	
Microbial biomass:		
At initiation	Not reported	
At termination	Not reported	
Soil taxonomic classification (WRB)	Not reported	

Data obtained from p. 12 and Appendix 2, pp. 92-95 of the study report. Test soil provided by Hummert International, Earth City, Missouri (Item # 79VV9600).
1 Reviewer-calculated as % organic carbon = % organic matter/1.724.

B. Study Design

1. Experimental Conditions

Closed dome systems (humidomes) were configured to capture vapor phase dicamba on PUF sampling tubes following the application of the tank mixes to soil (pp. 11-12). The humidomes were disposable, plastic, sealed containers that allow for controlled environmental conditions and were modified to allow dicamba sample collection on the PUF media. Assembled, closed humidomes (10" wide x 20" long x 6" deep) were placed in a temperature and humidity controlled environmental chamber (20 ft x 30 ft x 11 ft). On each humidome lid a *ca.* 7/8" diameter air outlet hole on one end of the disposable, clear, plastic dome lid was cut for insertion of the PUF sample tube. The hole was located two inches from the top of the lid. Lids designated for collection of a duplicate PUF sample had a second *ca.* 7/8" hole cut two inches from the top of the lid and two inches laterally from the first hole. All lids had an *ca.* 7/8" air inlet hole on the opposite end to allow the free flow of air through the humidome. This hole was plugged with a #3 rubber stopper after the lid was mounted on the dosed soil tray and until an experiment began. The labelled PUF sample tube was mounted to one of the holes cut into each lid. The PUF tube extended *ca.* 1 inch into the humidome. The PUF tube was securely mounted to the lid using a grommet. PUF sample tubes were installed on the lid immediately prior to installation over the bottom tray loaded with the dosed soil.

After being sprayed, the assembled closed humidomes were moved to a temperature and humidity controlled environmental chamber and installed to achieve random placement; no two replicates of any spray solution were found on the same rack or shelf.

The percent relative humidity was monitored with a TSI Velocity Meter (p. 13). The temperature of the environmental chamber was monitored using six thermocouples (one on each rack). Chamber lights were programmed to be on for 14 hours and off for 10 hours at an average intensity of *ca.* 50 µmoles/meter^2/second. Light intensity was measured using a Hydrofarm Quantum PAR meter at the center of each humidome tray and a few inches above the shelf prior to testing. After 24 hours, the PUF samples were removed from the lid of the humidome and the humidome was removed from the environmental chamber.

A summary of the experimental design is provided in **Table 3**.

Table 3. Experimental Design

Parameter	Description
Duration of the test (hours)	24
Soil condition (Air dried/fresh)	Mixed, non-compacted, sifted with a ¼-in (0.635 cm) opening sieve screen
Soil sample weight (g/replicate)	Not reported, *ca.* 1 liter
Soil depth (cm)	Not reported; 0.129 m^2 (area of dosed soil)
Test concentration (mg ai/kg soil (dry weight))[1]	7.45 mg a.e. dicamba per tray Soil wt. not reported 15.2 gallons solution per acre
Field Equivalent Application Rate (lb a.i./A)	*ca.* 0.5 lb a.e. dicamba/A [15 gallons per acre (GPA) equivalent to 0.5 lb a.e. dicamba/A]
Number of replicates	3 for each of the four tank mixes at the three pHs
Test apparatus	Closed dome systems (humidomes) configured to capture dicamba on polyurethane foam media.

Parameter		Description
Test material application	Test solution volume used/ treatment[2]	*ca.* 0.0005 gal *ca.* 29 mL of formulated product in 1 L of water (0.101 gallons/minute)
	Application method	Sprayer equipped with TP9501E nozzle at 40 PSI at 16 inches above the tray bottoms (16 inches above benchtop).
Indication of test material adsorbing to walls of test apparatus?		No
Experimental conditions	Temperature (°C)	35 ± 5°C
	Relative humidity	40 ± 5%
	Soil moisture content	12-22% (target)
	Moisture maintenance method	Not reported
	Air flow through system	1.85 ± 0.10 L/minute
	Continuous darkness (Yes/No):	No; 14-hour day light cycle, *ca.* 50 µmoles/meter^2/second.
Other observations (if applicable)		QC samples of undosed soil were prepared in the same manner as the test samples.

Data obtained from pp. 12-14, 17, of the study report.
[1] Not reported; could not be calculated since soil weight per replicate and soil density not reported.
[2] Reviewer calculated based on application volume of 15.2 GPA and soil area of 0.129 m^2.

2. Sampling during Study Period

After 24 hours, the vacuum pump was turned off, and the PUF sampling tubes were removed and individually wrapped in aluminum foil prior to processing and analysis (p. 13).

No soil samples were collected. Further details of the study design are shown in **Table 4**.

Table 4. Sampling Design

Parameter	Description
Air Sampling	
Sample intervals (hrs)	24
Sampling method	Polyurethane foam sample tubes
Desired air flow of sampler (L/min)	1.85 ± 0.10 L
Sample storage before analysis (Yes/No)?	Yes; stored in a freezer (<-10°C) until shipment for analysis; 1 day in frozen storage.
Soil Sampling	
Sample intervals	Not sampled
Sampling method	Not sampled
Sample storage before analysis (Yes/No)?	Not sampled

Data obtained from p. 13 and Appendix 1, Table 1, pp. 66-67, of the study report.

3. Sample Handling and Storage Stability

After collection, samples were removed from the humidomes, wrapped in foil, and stored in a freezer (< -10°C) until shipment for analysis at Battelle, Norwell, Massachusetts (pp. 13, 15; Appendix 1, p. 38). Method ME-1902-02 reported that samples should be stored at -20°C when not in use (Appendix 1, p. 47).

4. Analytical Procedures

Extraction methods: Polyurethane foam air sampling traps were spiked with 0.1 mL of acetonitrile then extracted in a single extraction using methanol containing stable-labeled internal standard (Method ME-1902-02; Appendix 1, pp. 47-48; Appendix 1, Appendix 2, p. 82). The sample tubes were capped and agitated on a high-speed shaker for 30 minutes. An aliquot of the supernatant was filtered, evaporated under nitrogen gas at 50ºC, and reconstituted in up to 10-fold less volume of 25% methanol in water. Dicamba was quantitated using LC-MS/MS with electrospray ionization in negative ion mode. Ten modifications or deviations from Method ME-1902-02 were incorporated into the analysis, many of which were adjustments to the analytical parameters (Appendix 1, pp. 55-59).

Total Radioactivity Measurement: Not applicable

Identification and Quantification of Parent Compound: Aliquots of the sorbent extracts were analyzed for dicamba using LC-MS/MS under the following conditions (Method ME-1902-02; Appendix 1, pp. 47-48; Appendix 1, Appendix 2, pp. 82-83):

HPLC	Shimadzu
Mass Spectrometer	AB Sciex API 6500
Switching Valve	Not reported
Data Software	Not reported
Column	Phenomenex Kinetex Biphenyl (3.0 × 50 mm, 2.6-µm) Phenomenex SecurityGuard Biphenyl column 3.0 mm
Mobile Phase	A: 0.05% aqueous formic acid B: Methanol

Time (minutes)	% A	% B	Flow Rate (mL/min.)	Divert
0	80	20	0.500	
4.00	45	55	0.500	
4.01	5	95	0.500	
6.00	5	95	0.500	
6.01	80	20	0.500	
7.00	80	20	0.500	Stop

Column Temperature	40ºC
Autosampler Temp	10ºC
Injection Volume	35 µL (3.5 µL for dilution analysis)
Ionization Mode	ESI, negative ion mode
Curtain Gas	Nitrogen, 10 psi
Collision Gas	"Low"
IonSpray Voltage	-4500 V
Source Temperature	600ºC
Ion Source Gas 1	Nitrogen, 60 psi
Ion Source Gas 2	Nitrogen, 50 psi
Interface Heater	Not reported

Probe Position	Not reported
MRM Transitions	219/175 Da (Dicamba); 225/181 Da (Dicamba-$^{13}C_6$)
Confirmatory Ions	221/177 Da (Dicamba); 227/183 Da (Dicamba-$^{13}C_6$)
Declustering Potential	-40 V
Entrance Potential	-10 V
Collision Energy	-10 V
Collision Cell Exit Potential	-10 V

Detection Limits (LOD, LOQ) for the Parent Compound: The limit of detection (LOD) was determined to be 0.3 ng/PUF, with a limit of quantitation (LOQ) of 1.0 ng/PUF (Method ME-1902-02; p. 8; Appendix 1, p. 48).

Detection Limits (LOD, LOQ) for the Transformation Products: No transformation products were evaluated in the study.

Instrument performance: A calibration curve based on calibration standards at concentration levels of 3.0-750 ng/mL (0.30-75 ng/PUF) for dicamba was calculated (Appendix 1, p. 47; Appendix 1, Appendix 4, Figure 1, pp. 86-87).

Lab recovery, air sampling sorbent material: All laboratory spike recoveries are within the acceptable range with overall recoveries at 71-118%, except for the quantitation ion transition analysis of one of the 60×LOQ samples (133%; Appendix 1, pp. 48-49).

Lab recovery, soils: Not applicable

Breakthrough, air samples: Test substance breakthrough was not investigated.

II. Results and Discussion

A. Study Conditions

Temperature and relative humidity were maintained throughout the study in the environmental chamber (p. 12; Appendix B, pp. 61-62). Soil moisture measured prior to applying test material was not reported or evaluated during the trial. Microbial biomass was not evaluated.

B. Data

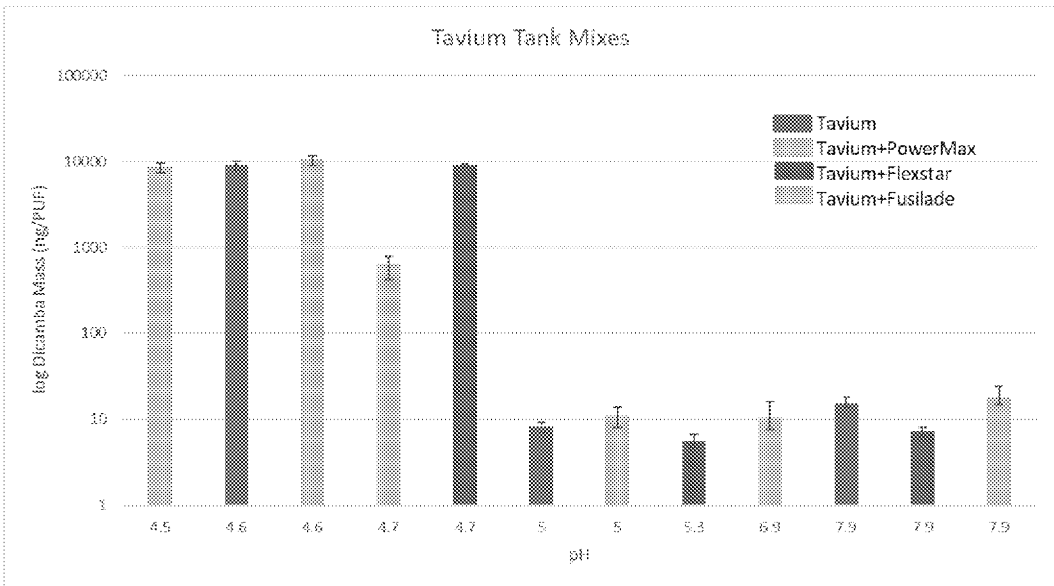
Sample durations, sample volume flowrates, and the mass, 24-hour average air concentration, and flux rates of dicamba collected on the sorbent material for each dicamba DGA formulation and the control (un-dosed soil blanks) are shown in **Table 5**. Air concentrations were reported in the study report by dividing the corrected mass of dicamba by product of the sample volume flowrate and sample duration (p. 15; Table 8, pp. 27-28). Volatilization flux rates were estimated in the study report by dividing the corrected mass on the sampling media (ng) by the area of soil dosed with dicamba (0.129 m^2) and the elapsed time of sample collection (p. 15).

After 24 hours, air concentrations ranged from 3 to 3760 ng/m^3 for Tank Mix 1 – Tavium® and Intact®, 3 to 3600 ng/m^3 for Tank Mix 2 – Tavium®, RoundUp Power MAX®, and Intact®, 2 to

3478 ng/m^3 for Tank Mix 3 – Tavium®, Flexstar®, and Intact®, 3 to 4346 ng/m^3 for Tank Mix 4 – Tavium®, Fusilade® DX, and Intact®, and 0 to 0.11 ng/m^3 for un-dosed soil blanks (control).

After 24 hours at 35°C and 40% relative humidity, the 24-hour average volatilization rates for dicamba in the tested soil ranged from 0.71 to 0.89 ng/m^2-s in the pH 4.62 tank mix of Tank Mix 1 – Tavium® and Intact® (tank mix pH range 4.62-7.89), 0.66 to 0.86 ng/m^2-s in the pH 4.46 tank mix of Tank Mix 2 – Tavium®, RoundUp Power MAX®, and Intact® (tank mix pH range 4.46-6.93), 0.78 to 0.83 ng/m^2-s in the pH 4.74 tank mix of Tank Mix 3 – Tavium®, Flexstar®, and Intact® (tank mix pH range 4.74-7.90), and 0.8 to 1.03 ng/m^2-s in the pH 4.62 tank mix of Tank Mix 4 – Tavium®, Fusilade® DX, and Intact® (tank mix pH range 4.62-7.89; Table 8, pp. 27-28). In the un-dosed soil blanks (control), the maximum volatilization rate for dicamba was 2.69×10^{-5} ng/m^2-s, equivalent to the limit of detection, after 24 hours at 35°C and 40% relative humidity. At pH values of 7 and 8, flux rates ranged from 4.13×10^{-4} to 7.10×10^{-2} ng/m^2-s.

Figure 1 depicts the trend of dicamba mass volatilized versus pH for the different tank mixes. The study author evaluated the relative dicamba volatility using the Wilcoxon Test, performed to compare across pH groups (p. 16). A statistically significant difference (95% confidence level) was observed between the dicamba mass detected at the lowest initial carrier pH (pH 4) and volatilized mass measured when the target water solution was 7 or 8. There was no observed significant difference between 7 and 8 pH levels. Measured mass for the pH 4 experimental data (tank mix pH range 4.46-4.74; final water pH 4.28) ranged from 7310 to 11500 ng/PUF. The pH 7 experimental data (tank mix pH range 4.68-5.34; final water pH 7.09) exhibited mass ranges from 4.6 to 791 ng/PUF. The pH 8 (tank mix pH range 6.93-7.90; final water pH 8.26) produced the lowest mass range with values ranging from 6.4 to 24 ng/PUF.



C. Material Balance

No material balance or distribution of dicamba in the air and soil was calculated in the study.

Table 5. Volatility of dicamba from soil after 24 hours at 35°C and 40% relative humidity

Tank Mix pH		4.62			5.04			7.89		
Air Concentration Analyses – Tank Mix 1 – Tavium® and Intact®										
Sample Duration (hours)		24			24			24		
Sample Volume Flowrate (m^3/s)		3.06E-05	3.02E-05	3.05E-05	3.07E-05	3.03E-05	3.06E-05	3.07E-05	3.07E-05	3.06E-05
Parent	Measured mass (ng)	9160	7930	9910	7	9.3	8.3	14	18	14
	Air concentration (ng/m^3)	3460	3040	3760	2.6	3.6	3.1	5.3	6.8	5.3
	Volatility (ng/m^2-s)	8.22E-01	7.11E-01	8.89E-01	6.28E-04	8.34E-04	7.45E-04	1.26E-03	1.61E-03	1.26E-03

Data obtained for measured mass from Table 8, pp. 27-28, flowrate from Table 6, pp. 24-25, duration from p. 8, and air concentration and volatilization flux from Table 8, pp. 27-28, of the study report (measured mass values were corrected for blank mass values in air concentration and volatilization flux calculations; p. 15). Dosed soil, no flow had <LOD to 0.14 ng of dicamba mass measured. PUF blank had <LOD to 0.78 ng of dicamba mass measured.

Tank Mix pH		4.46			4.68			6.93		
Air Concentration Analyses – Tank Mix 2 – Tavium®, RoundUp Power MAX®, and Intact®										
Sample Duration (hours)		24			24			24		
Sample Volume Flowrate (m^3/s)		3.06E-05	3.06E-05	3.08E-05	3.05E-05	3.06E-05	3.01E-05	3.05E-05	3.05E-05	3.13E-05
Parent	Measured mass (ng)	9250	7310	9570	791	420	727	16	7.8	7.7
	Air concentration (ng/m^3)	3497	2761	3600	300	159	279	6.1	3.0	2.8
	Volatility (ng/m^2-s)	8.30E-01	6.56E-01	8.59E-01	7.10E-02	3.77E-02	6.52E-02	1.44E-03	7.00E-04	6.91E-04

Data obtained for measured mass from Table 8, pp. 27-28, flowrate from Table 6, pp. 24-25, duration from p. 8, and air concentration and volatilization flux from Table 8, pp. 27-28, of the study report (measured mass values were corrected for blank mass values in air concentration and volatilization flux calculations; p. 15). Dosed soil, no flow had <LOD to 0.14 ng of dicamba mass measured. PUF blank had <LOD to 0.78 ng of dicamba mass measured.

Tank Mix pH		4.74			5.34			7.90		
Air Concentration Analyses – Tank Mix 3 – Tavium®, Flexstar®, and Intact®										
Sample Duration (hours)		24			24			24		
Sample Volume Flowrate (m^3/s)		3.05E-05	3.08E-05	3.09E-05	3.05E-05	3.01E-05	3.18E-05	3.03E-05	3.09E-05	3.04E-05
Parent	Measured mass (ng)	9010	8680	9300	4.6	6.6	5.7	8.0	6.4	7.7
	Air concentration (ng/m^3)	3422	3259	3478	1.7	2.5	2.1	3.1	2.4	2.9
	Volatility (ng/m^2-s)	8.08E-01	7.79E-01	8.34E-01	4.13E-04	5.92E-04	5.11E-04	7.18E-04	5.74E-04	6.91E-04

Data obtained for measured mass from Table 8, pp. 27-28, flowrate from Table 6, pp. 24-25, duration from p. 8, and air concentration and volatilization flux from Table 8, pp. 27-28, of the study report (measured mass values were corrected for blank mass values in air concentration and volatilization flux calculations; p. 15). Dosed soil, no flow had <LOD to 0.14 ng of dicamba mass measured. PUF blank had <LOD to 0.78 ng of dicamba mass measured.

Tank Mix pH		4.62			5.03			7.89		
Air Concentration Analyses – Tank Mix 4 – Tavium®, Fusilade® DX, and Intact®										
Sample Duration (hours)		24			24			24		
Sample Volume Flowrate (m^3/s)		3.06E-05	3.05E-05	3.06E-05	3.05E-05	3.03E-05	3.04E-05	3.06E-05	3.08E-05	3.06E-05
Parent	Measured mass (ng)	11000	8880	11500	11	8	14	16	15	24
	Air concentration (ng/m^3)	4156	3372	4346	4.2	3.1	5.3	6.0	5.6	9.1
	Volatility (ng/m^2-s)	9.87E-01	7.97E-01	1.03E+00	9.87E-04	7.18E-04	1.26E-03	1.44E-03	1.35E-03	2.15E-03

Data obtained for measured mass from Table 8, pp. 27-28, flowrate from Table 6, pp. 24-25, duration from p. 8, and air concentration and volatilization flux from Table 8, pp. 27-28, of the study report (measured mass values were corrected for blank mass values in air concentration and volatilization flux calculations; p. 15). Dosed soil, no flow had <LOD to 0.14 ng of dicamba mass measured. PUF blank had <LOD to 0.78 ng of dicamba mass measured.

Control				
Air Concentration Analyses – Un-dosed soil blanks				
Sample Duration (hours)		24		
Sample Volume Flowrate (m^3/s)		3.01E-05	3.05E-05	3.05E-05
Parent	Measured mass (ng)	<LOD	0.06	0.27
	Air concentration (ng/m^3)	--	0.14	0.14
	Volatility (ng/m^2-s)	--	2.69E-05	2.69E-05

Data obtained for measured mass and air concentration from Table 11, p. 30, flowrate from Table 6, pp. 24-25, and duration from p. 8, of the study report. Measured mass values below the detection limit were set to the detection limit. Dosed soil, no flow had <LOD to 0.14 ng of dicamba mass measured.

D. Transformation Products

The study does not address transformation products.

III. Study Deficiencies and Reviewer's Comments

1. The test soil was only partially characterized. The field soil was characterized without USDA soil texture classification, and the Berger BM2 Germinating Mix was not characterized (p. 12; Appendix 2, pp. 92-95). Test soil provided by Hummert International (Item # 79VV9600). Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not as absolute values.

2. The soil weight for each humidome tray was not reported; therefore, the reviewer could not calculate the application rate in kg a.e. dicamba/ha.

3. The stability of dicamba at room temperature was not reported. From receipt on 08/30/2019 until 10/08/2019, the test substance was stored at standard office conditions; it was moved to the storage area [<30°C (actual range was 18.0-24.0°C)] until use (p. 3; Table 1, p. 21).

4. Appendix 5 (pp. 99-105) contained data not used. During this dicamba volatility study, quality control samples did not pass acceptance criteria (>30% of LOQ for PUF blanks).

5. The calibration curve for the analytical portion of the study report was based on calibration standards at concentration levels of 3.0-750 ng/mL (0.30-75 ng/PUF) for dicamba (Appendix 1, p. 47; Appendix 1, Figure 1, pp. 86-87). The concentrations of the standards did not appear to bracket the concentrations in the samples being analyzed (Appendix 1, Tables 4-5, pp. 72-77).

IV. References

1. U.S. Environmental Protection Agency. 2008. Fate, Transport and Transformation Test Guidelines, OCSPP 835.1410, Laboratory Volatility. Office of Chemical Safety and Pollution Prevention, Washington, DC. EPA 712-C-08-011.

2. Gavlick, W.K., Wright, D.R., MacInnes, A., Hemminghaus, J.W., Webb, J.K., Yermolenka, V.I., and Su, W. 2016. "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations," Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587, G.R. Goss, Ed., ASTM International, West Conshohocken, PA, pp. 24-32.

3. 40 CFR 160, "Part 160—Good Laboratory Practice Standards." Code of Federal Regulations, Title 40, Volume 23, Chapter 1, (40 CFR 160), Federal Register, Volume 54, pp. 34067, August 17, 1989.

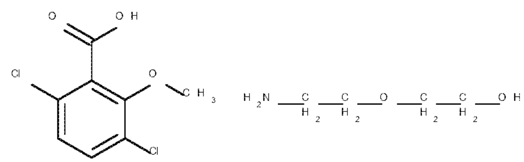
4. U.S. EPA. 2019. Notice of Pesticide Registration, EPA Registration Number: 100-1623, Date of Issuance: 4/5/2019, Name of Pesticide Product: A21472 PLUS VAPORGRIP TECHNOLOGY, Decision Number: 527213.

DER ATTACHMENT 1. Dicamba-diglycolamine and S-metolachlor and Its Environmental Transformation Products. [A]

<table>
<tr><th>Code Name/ Synonym</th><th>Chemical Name</th><th>Chemical Structure</th><th>Study Type</th><th>MRID</th><th>Maximum %AR (day)</th><th>Final %AR (study length)</th></tr>
<tr><td colspan="7">PARENT</td></tr>
<tr><td>Dicamba-diglycolamine (Diglycolamine salt of dicamba)</td><td>IUPAC: 3,6-Dichloro-o-anisic acid-2-(2-aminoethoxy)ethanol

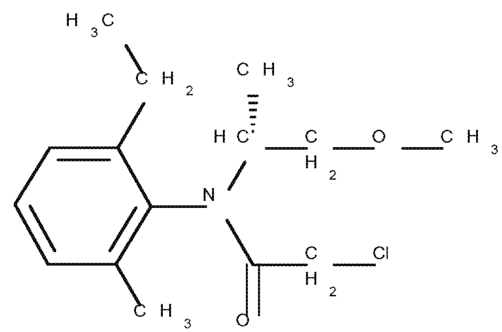
CAS: 2-(2-Aminoethoxy)ethanol;3,6-dichloro-2-methoxy-benzoic acid

CAS No.: 104040-79-1

Formula: $C_{12}H_{17}Cl_2NO_5$
MW: 326.17 g/mol
SMILES: COc1c(Cl)ccc(Cl)c1C(=O)O.NCCOCCO</td><td></td><td rowspan="2">Non-guideline (Humidome)</td><td rowspan="2">50958207</td><td rowspan="2">NA</td><td rowspan="2">NA</td></tr>
<tr><td>S-metolachlor</td><td>IUPAC: 2-Chloro-N-(6-ethyl-o-tolyl)-N-[(1S)-2-methoxy-1-methylethyl]acetamide

CAS: 2-Chloro-N-(2-ethyl-6-methylphenyl)-N-[(1S)-2-methoxy-1-methylethyl]acetamide

CAS No.: 87392-12-9

Formula: $C_{15}H_{22}ClNO_2$
MW: 283.8 g/mol
SMILES: Cc1cccc(CC)c1N(C(=O)CCl)C(C)COC</td><td></td></tr>
<tr><td colspan="7">MAJOR (>10%) TRANSFORMATION PRODUCTS</td></tr>
<tr><td colspan="7">No major transformation products were identified.</td></tr>
<tr><td colspan="7">MINOR (<10%) TRANSFORMATION PRODUCTS</td></tr>
</table>

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

128931+_50958207_D
ER-Fate_NG-Humidon